

WHAT IS CLAIMED IS:

- 1 *gb* 1. A wafer transfer machine for transferring wafers from either of a first wafer
2 *pl* cassette and a second wafer cassette into the other, comprising:
- 3 (a) a support structure having a support surface for supporting the first and
4 second wafer cassettes;
- 5 (b) a first registration feature located in fixed relationship to the support
6 surface for engaging a registration feature of the first wafer cassette, and a second registration
7 feature located in fixed relationship to the support surface for engaging a registration feature of
8 the second wafer cassette;
- 9 (c) a carriage mechanism supported by and movable in opposite directions
10 along a track mechanism that is supported in fixed relationship to the support structure; and
- 11 (d) a first wafer pushing member rigidly connected to the carriage mechanism
12 for engaging edges of semiconductor wafers in the first wafer cassette and pushing them out of
13 the first wafer cassette into the second wafer cassette, and a second wafer pushing member
14 rigidly connected to the carriage mechanism for engaging edges of semiconductor wafers in the
15 second wafer cassette and pushing them out of the second wafer cassette into the first wafer
16 cassette.

1 2. A method of transferring wafers from either of a first wafer cassette and a second
2 wafer cassette into the other wafer cassette, comprising:

3 (a) supporting the first wafer cassette adjacent to and in alignment with the
4 second wafer cassette such that wafer slots of the first wafer cassette are precisely aligned with
5 wafer slots of the second wafer cassette, one of the first and second wafer cassettes being loaded
6 with semiconductor wafers and the other of the first and second wafer cassettes being empty;

7 (b) supporting a first wafer pushing member and a second wafer pushing
8 member by a mechanism for selectively moving the first wafer pushing member into and out of
9 the first wafer cassette and also selectively moving the second wafer pushing member into and of
10 the second wafer cassette; and

11 (c) operating a mechanism to move the one of the first wafer pushing member
12 and the second wafer pushing member which is closest to the semiconductor wafers in the loaded
13 wafer cassette to engage the edges of the semiconductor wafers and push them out of the loaded
14 wafer cassette into the empty wafer cassette.

1 3. A wafer transfer machine for transferring wafers from either of a first wafer
2 cassette and a second wafer cassette having incompatible registration features into the other,
3 comprising:

- 4 (a) a support plate having a top surface for supporting the first and second
5 wafer cassettes;
- 6 (b) a first registration boss attached to the top surface for extending upward
7 into and engaging a registration feature of the first wafer cassette, and a second registration boss
8 attached to the top surface for extending upward into and engaging a registration feature of the
9 second wafer cassette;
- 10 (c) a carriage supported by and movable in opposite directions along a track
11 mechanism that is attached in fixed relationship to the support plate; and
- 12 (d) a first wafer pushing member rigidly connected to the carriage for
13 engaging edges of semiconductor wafers in the first wafer cassette and pushing them out of the
14 first wafer cassette into the second wafer cassette, and a second wafer pushing member rigidly
15 connected to the carriage for engaging edges of semiconductor wafers in the second wafer
16 cassette and pushing them out of the second wafer cassette into the first wafer cassette.

1 4. The wafer transfer machine of claim 3 including a handle attached to the carriage
2 for manually moving carriage along the track mechanism to cause one of the first and second
3 wafer pushing members to push wafers from one of the first and second wafer cassettes into the
4 other.

1 5. The wafer transfer machine of claim 3 wherein the support plate, carriage, and the
2 first and second wafer pushing members are composed of plastic material.

1 6. The wafer transfer machine of claim 3 wherein the track mechanism includes
2 cylindrical first and second slide rods which are parallel to the top surface of the support plate
3 and are parallel to each other.

1 7. The wafer transfer machine of claim 6 wherein the carriage includes parallel first
2 and second cylindrical holes through which the first and second slide rods, respectively, extend
3 to allow bidirectional sliding of the carriage along the first and second slide rods.

1 8. The wafer transfer machine of claim 3 wherein the track mechanism and carriage
2 are underneath the support plate, and wherein the support plate includes a first elongated slot
3 through which the first wafer pushing member extends upward to a level of wafers supported in
4 the first wafer cassette, and wherein the support plate includes a second elongated slot through

5 which the first wafer pushing member extends upward to a level of wafers supported in the
6 second wafer cassette.

1 9. The wafer transfer machine of claim 8 wherein the first and second wafer pushing
2 members are supported by opposite ends of a push-pull rod extending through the third
3 cylindrical hole of the carriage and rigidly attached to the carriage.

4 10. The wafer transfer machine of claim 9 wherein the first wafer pushing member
5 includes a first vertical section having a lower end rigidly attached to a first end section of the
6 push-pull rod, a first horizontal section having a first end attached to and integral with an upper
7 end of the first vertical section and also having a second end attached to and integral with a lower
8 end of a second vertical section, and wherein the second wafer pushing member includes a third
9 vertical section having a lower end rigidly attached to a second end section of the push-pull rod,
a second horizontal section having a first end attached to and integral with an upper end of the
third vertical section and also having a second end attached to and integral with a lower end of a
fourth vertical section.

1 11. The wafer transfer machine of claim 4 including an alignment knob attached to an
2 edge of the support plate in a location aligned with the handle when the carriage is located at a
3 center position which allows placing and removal of the first and second wafer cassettes in
4 engagement with the first and second registration bosses, respectively, and allows removal of the
5 first and second wafer cassettes from the support plate.

1 12. The wafer transfer machine of claim 8 including first, second, third, and fourth
2 legs supporting first, second, third, and fourth corner portions of the support plate, respectively,
3 wherein opposite ends of the first slide rod engage and are supported by the first and fourth legs,
4 respectively, and wherein opposite ends of the second slide rod engage and are supported by the
5 second and third legs, respectively.

1 13. A wafer transfer machine for transferring wafers from either of a first wafer
2 cassette and a second wafer cassette having incompatible registration features into the other,
3 comprising:

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- 4 (a) support means for supporting the first and second wafer cassette;
- 5 (b) registration means attached to the support means for extending upward
- 6 into and engaging registration features of the first wafer cassette and the second wafer cassette;
- 7 (c) a track mechanism and means for supporting the track mechanism in fixed
- 8 relationship to the support plate;
- 9 (d) carriage means for movement in opposite directions along the track
- 10 mechanism; and
- 11 (e) first wafer pushing means supported by the carriage means for engaging
- 12 edges of semiconductor wafers in the first wafer cassette and pushing them out of the first wafer
- 13 cassette into the second wafer cassette in response to movement of the carriage means along the
- 14 track mechanism in a first direction, and a second wafer pushing means supported by the carriage
- 15 means for engaging edges of semiconductor wafers in the second wafer cassette and pushing
- 16 them out of the second wafer cassette into the first wafer cassette in response to movement of the
- 17 carriage means along the track mechanism in a second direction.

1 14. A method of transferring wafers from either of a first wafer cassette and a second
2 wafer cassette having incompatible registration features into the other wafer cassette, comprising:

3 (a) supporting the first wafer cassette on a support plate in registration with a
4 first registration boss extending into and engaging a registration feature of the first wafer
5 cassette, and supporting the second wafer cassette on the support plate in registration with a
6 second registration boss extending into and engaging a registration feature of the second wafer
7 cassette, one of the first and second wafer cassettes being loaded with semiconductor wafers and
8 the other of the first and second wafer cassettes being empty;

9 (b) supporting a first wafer pushing member and a second wafer pushing
10 member by means of a carriage supported by and movable in opposite directions along a track
11 mechanism; and

12 (c) moving the carriage in a direction that causes one of the first wafer
13 pushing member and the second wafer pushing member which is closest to the semiconductor
14 wafers in the loaded wafer cassette to engage the edges of the semiconductor wafers and push
15 them out of the loaded wafer cassette into the empty wafer cassette.

1 15. The method of claim 14 further including moving the carriage to a centered
2 position that allows removal of the first and second wafer cassettes from the support plate.

1 16. A machine for transferring wafers from either of a first wafer cassette and a
2 second wafer cassette into the other wafer cassette, comprising:

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3 (a) means for supporting the first wafer cassette adjacent to and in alignment
4 with the second wafer cassette such that wafer slots of the first wafer cassette are precisely
5 aligned with wafer slots of the second wafer cassette, one of the first and second wafer cassettes
6 being loaded with semiconductor wafers and the other of the first and second wafer cassettes
7 being empty;

8 (b) means for supporting a first wafer pushing member and a second wafer
9 pushing member by a mechanism for selectively moving the first wafer pushing member into and
10 out of the first wafer cassette and also selectively moving the second wafer pushing member into
11 and of the second wafer cassette; and

12 (c) means for moving the one of the first wafer pushing member and the
13 second wafer pushing member which is closest to the semiconductor wafers in the loaded wafer
14 cassette to engage the edges of the semiconductor wafers and push them out of the loaded wafer
15 cassette into the empty wafer cassette.